Statistical Summaries of Streamflow in Oklahoma through 1999

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ABSTRACT

Statistical summaries of streamflow records through 1999 for gaging stations in Oklahoma and parts of adjacent states are presented for 188 stations with at least 10 years of streamflow record. Streamflow at 113 of the stations is regulated for specific periods. Data for these periods were analyzed separately to account for changes in streamflow due to regulation by dams or other human modification of streamflow.

A brief description of the location, drainage area, and period of record is given for each gaging station. A brief regulation history also is given for stations with a regulated streamflow record. This descriptive information is followed by tables of mean annual discharges, magnitude and probability of exceedance of annual high flows, magnitude and probability of exceedance of annual instantaneous peak flows, durations of daily mean flow, magnitude and probability of non-exceedance of annual low flows, and magnitude and probability of non-exceedance of seasonal low flows.

INTRODUCTION

Streamflow statistics are used by individuals and organizations involved in the planning of projects with surface-water resources. The last report that published summaries of streamflow statistics in Oklahoma used streamflow data through 1984 (Heimann and Tortorelli, 1988). The U. S. Geological Survey (USGS), in cooperation with the Oklahoma Department of Environmental Quality, conducted an investigation to update streamflow statistics in Oklahoma.

At least 10 years of daily streamflow data exist for 174 streamflow gaging stations in Oklahoma and 14 in nearby parts of adjacent states. Since 1984 there have been several streamflow sites: 1) with additional years of record, or 2) not previously analyzed that are included because they now have 10 years or more of data, or 3) that are now regulated. Useful summaries for streamflow data represent mean annual flow, low- and high-flow frequency statistics, peak-flow statistics, and flow-duration statistics. Information about mean annual flow, low-flow and high-flow characteristics, and flow-duration statistics is essential to water-management agencies dealing with problems related to irrigation, municipal and industrial water supplies, and fish and wildlife conservation.

Low-flow statistics are particularly important to assess the capability of a stream to receive and assimilate treated wastewater. Low-flow statistics are used in developing wastewater permits and determining total maximum daily loads of streams. Annual and seasonal 7-day, 2-year low-flow streamflows are used as part of the criteria for developing wasteload allocations for permit purposes and is specifically cited in State statutes. Other low-flow durations (1, 3, 10, 30, and 60 days) and frequencies (5, 10, and 20 years) also are useful to characterize streamflow at a site.

Knowledge of high-flow and peak-flow statistics is required for the safe and economical design of highway bridges, culverts, dams, levees, and other structures on or near streams and for disaster planning. Flood plain management programs and flood-insurance rates also are based on peak-flow magnitude and frequency information.

Purpose and Scope

The purposes of this report are to: (1) update mean annual flow, annual low- and high-flow statistics, and flow-duration statistics for each streamflow gaging station with 10 years or more of streamflow record; (2) present seasonal low-flow statistics for these gaging stations for three Oklahoma growth seasons: (a) spring (April 1 - May 31), (b) summer (June 1 - October 31), and (c) winter (November 1 - March 31); (3) update annual peak-flow statistics of these gaging stations; and (4) present analyses of unregulated and regulated periods of record separately, to reconcile changes in streamflow due to regulating structures and other human modifications of streamflow.

The scope of this report was limited to stations with at least 10 years of unregulated or regulated streamflow records through September 1999. A total of 188 streamflow gaging station records were analyzed, with 174 stations in Oklahoma and 14 nearby stations in Kansas, Missouri, Arkansas, and Texas. The streamflow records are from unregulated streams with no significant flow regulation, irrigation or urbanization, and from streams that are significantly affected by regulation, irrigation, and urbanization. Significant regulation by dams or other human modification of streamflow is defined as 20 percent or more of the contributing drainage basin affected (Heimann and Tortorelli, 1988).

Acknowledgments

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STATISTICAL SUMMARIES

Site Selection

The sites selected for analysis are shown in figure 1 and described in table 1. For major streams flowing into Oklahoma, the nearest gaging stations in the nearby parts of adjacent states were selected for analysis. Fourteen stations on major rivers in adjacent states and 174 streamflow-gaging stations in Oklahoma were selected. Only continuous-record sites with at least 10 years of unregulated or regulated data were selected for analysis. Streamflow at 113 of the stations is known to be affected by regulation, urbanization, or irrigation well development (Wahl and Tortorelli, 1997) for specific periods. Fifty-two of the 113 stations were analyzed for both unregulated and human-modified periods. Two of the regulated sites in the 113 stations were analyzed for periods of flow regulation and separate periods of flow regulation with irrigation development. The drainage-area distribution of the streamflow gaging stations in the 242 analyses is shown in table 2.

A regulated period of record in this report is defined as the period during which at least 20 percent of the drainage area upstream of a station is controlled by dams, floodwater-retarding structures, or other human modification of streamflow (Heimann and Tortorelli, 1988). An urban period of record is defined as the period during which at least 20 percent of the drainage basin upstream of a station is impervious cover due to urbanization. An irrigation period of record is defined by those stations in the Beaver-North Canadian River above Canton Lake affected by irrigation well development in Wahl and Tortorelli (1997). Streamflow at some other stations likely has been affected by ground water development, but it has not been documented. If the flow at a streamflow station is regulated and the drainage basin area is significantly changed by further regulation or human modification, an attempt was made to define the regulated period when further change had substantively stopped. However, regulated statistics may be biased due to the extent regulation has changed during some regulated periods. The differences in statistical summaries for different periods of record at a site also may be the result of different climatic conditions rather than differences in regulation. The period of record by type of streamflow modification is listed in table 1.

Description of Streamflow Statistics Tables

The summary streamflow statistics tables presented in the back of this report for each station are

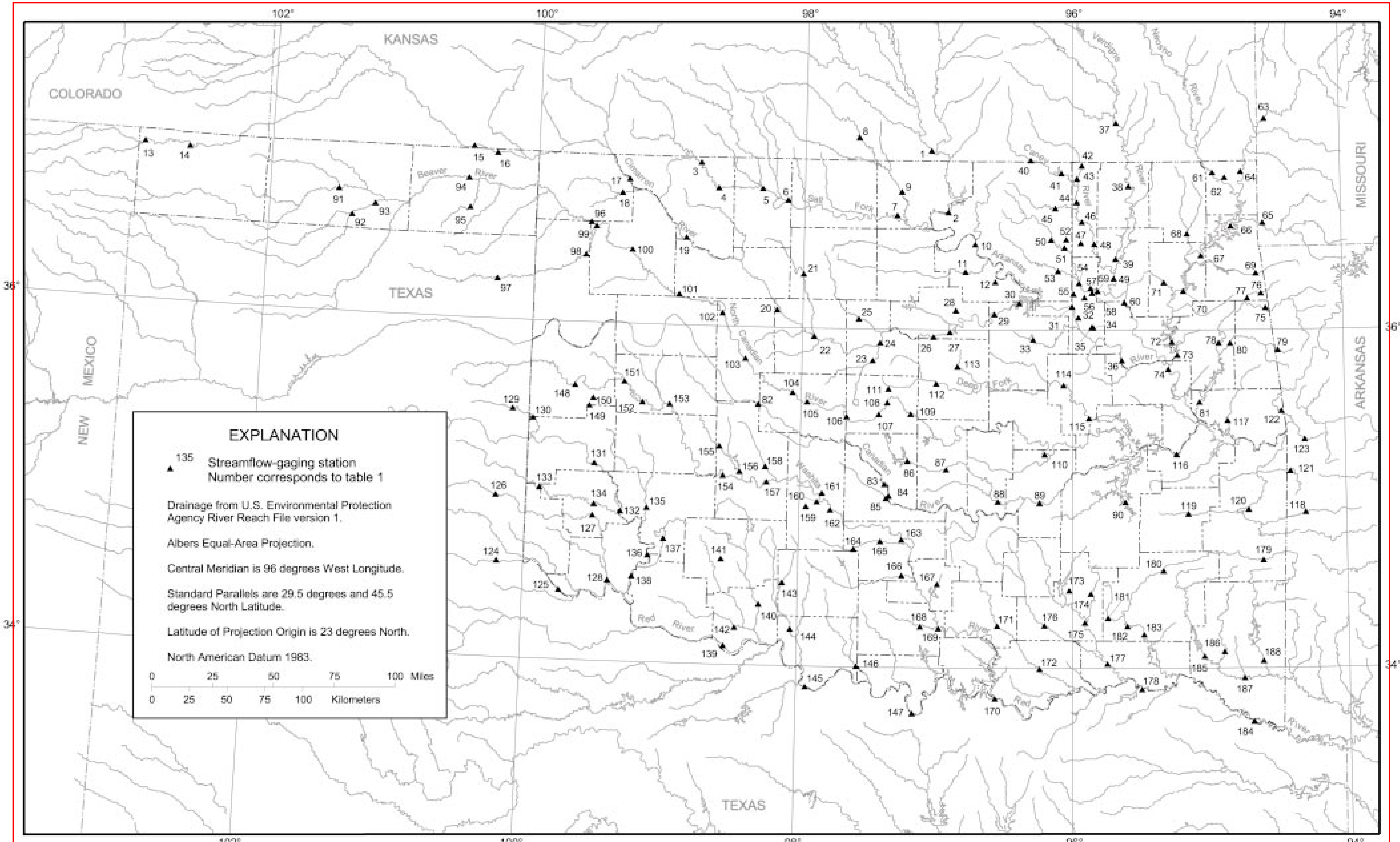

Figure 1. Location of streamflow-gaging stations with at least 10 years of streamflow data used in study.

Table 1. Summary of streamflow period of record used in study for selected continuous-record streamflow-gaging stations with at least 10 years of streamflow data from unregulated, regulated, and urban basins within and near Oklahoma

[I, irrigation; N, unregulated; R, regulated; U, urban; mi^2, square miles; dms, degrees, minutes, seconds; R., river; nr, near; Ck, Creek; abv, above; St, Street; L, Little; SWS, subwatershed; blw, below; Ave, Avenue; N., North; Lk, Lake; OKC, Oklahoma City; L&D, Lock and Dam; Fk, Fork; No., number; WY, water year]

Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
1	07146500	Arkansas River at Arkansas City, Kans.	N	1903-05, 22-42	36,106	370323	0970332
			R	1943-99			
2	07148140	Arkansas River near Ponca City, Okla.	R	1977-1993	38,923	364136	0965548
3	07148350	Salt Fork Arkansas R. nr Winchester, Okla.	N	1960-93	856	365742	0984655
4	07148400	Salt Fork Arkansas R. near Alva, Okla.	N	1938-51, 80-99	1,009	364854	0983852
5	07149500	Salt Fork Arkansas R. near Cherokee, Okla.	N	1941-50	2,439	364906	0981908
6	07150500	Arkansas River near Jet, Okla.	N	1938-40	3,194	364509	0980743
			R	1942-93			
7	07151000	Salt Fork Arkansas R. at Tonkawa, Okla.	N	1936-40	4,520	364019	0971833
			R	1942-99			
8	07151500	Chickaskia River near Corbin, Kans.	N	1951-65, 76-99	794	370744	0973604
9	07152000	Chikaskia River near Blackwell, Okla.	N	1937-99	1,859	364841	0971637
10	07152500	Arkansas River at Ralston, Okla.	N	1926-75	46,850	363015	0964341
			R	1977-99			
11	07153000	Black Bear Creek at Pawnee, Okla.	N	1945-62	576	362037	0964757
			R	1968-99			
12	07153100	Ranch Ck at Cleveland Dam nr Cleveland, Okla.	R	1946-63	21.9	361700	0963435
13	07154500	Cimarron River near Kenton, Okla.	N	1951-99	1,038	365536	1025731
14	07155000	Cimarron R. abv Ute Ck nr Boise City, Okla.	N	1943-54	1,879	365446	1023708
15	07156900	Cimarron River near Forgan, Okla.	N	1966-86, 88-99	4,220	370040	1002929
16	07157000	Cimarron River near Mocane, Okla.	N	1943-65	4,305	365833	1001850
17	07157950	Cimarron River near Buffalo, Okla.	N	1961-94	7,191	365107	0991854
18	07157960	Buffalo Creek near Lovedale, Okla.	N	1967-93	408	364614	0992200
19	07158000	Cimarron River near Waynoka, Okla.	N	1938-99	8,504	363102	0985245
20	07158400	Salt Creek near Okeene, Okla.	N	1962-67, 75-79	196	360611	0981136
21	07159000	Turkey Creek near Drummond, Okla. [1]	N	1948-70	248	361905	0980003
22	07159100	Cimarron River near Dover, Okla.	N	1974-99	10,787	355706	0975451
23	07159750	Cottonwood Creek near Seward, Okla.	R	1974-82, 91-99	320	354849	0972840
24	07160000	Cimarron River near Guthrie, Okla.	N	1938-76, 84-99	11,966	355514	0972532
25	07160500	Skeleton Creek near Lovell, Okla.	N	1950-93	410	360336	0973505
26	07161000	Cimarron River at Perkins, Okla.	N	1940-89	12,926	355727	0970154
27	07161450	Cimarron River near Ripley, Okla. [2]	N	1988-99	13,053	355909	0965443
28	07163000	Council Creek near Stillwater, Okla.	N	1935-93	31.0	360658	0965203
29	07163500	Cimarron River at Oilton, Okla.	N	1935-45	13,743	360538	0963452
30	07164000	Cimarron River at Mannford, Okla.	N	1939-50, 60-62	13,923	360940	0962310

Table 1. Summary of streamflow period of record used in study for selected continuous-record streamflow-gaging stations with at least 10 years of streamflow data from unregulated, regulated, and urban basins within and near Oklahoma—Continued

Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
31	07164500	Arkansas River at Tulsa, Okla.	N	1926-64	62,074	360826	0960022
			R	1965-99			
32	07164600	Joe Creek at 61st Street at Tulsa, Okla.	U	1989-99	12.2	360432	0955737
33	07165500	Polecat Creek below Heyburn Lake	N	1943-50	123	355642	0961739
		near Heyburn, Okla.	R	1951-79			
34	07165562	Haikey Ck at 101st St South at Tulsa, Okla.	U	1989-99	17.8	360101	0955055
35	07165565	L Haikey Ck at 101st St South at Tulsa, Okla.	U	1988-99	5.45	360103	0955138
36	07165570	Arkansas River near Haskell, Okla.	R	1973-99	62,932	354915	0953819
37	07170500	Verdigris River at Independence, Kans.	N	1896-1903, 22-59	2,892	371324	0954037
			R	1967-99			
38	07171000	Verdigris River near Lenapah, Okla.	N	1939-59	3,639	365104	0953509
			R	1967-99			
39	07171400	Verdigris River near Oologah, Okla.	R	1964-92	4,339	362514	0954103
40	07172000	Caney River near Elgin, Kans.	N	1940-64	445	370014	0961900
			R	1965-99			
41	07173000	Caney River near Hulah, Okla.	N	1938-50	733	365537	0960506
			R	1952-93			
42	07174000	Little Caney River near Copan, Okla.	N	1944-58	424	365815	0955605
43	07174200	Little Caney River below Cotton Creek	N	1959-64	502	365342	0955809
		near Copan, Okla. [3]	R	1969-80			
44	07174400	Caney R. abv Coon Ck at Bartlesville, Okla.	R	1986-99	1,392	364520	0955819
45	07174600	Sand Creek at Okesa, Okla.	N	1960-93	139	364310	0960756
46	07174700	Caney River near Ochelata, Okla.	R	1957-76	1,753	363826	0955602
47	07175000	Double Creek SWS 5 near Ramona, Okla.	R	1956-69	2.39	363050	0955625
48	07175500	Caney River near Ramona, Okla.	N	1945-50	1,955	363032	0955030
			R	1984-99			
49	07176000	Verdigris River near Claremore, Okla.	N	1936-62	6,534	361826	0954152
			R	1964-99			
50	07176465	Birch Ck blw Birch Lake near Barnsdall, Okla.	R	1978-92	66.0	363200	0960943
51	07176500	Bird Creek at Avant, Okla.	N	1946-76	364	362912	0960350
			R	1978-99			
52	07176800	Candy Creek near Wolco, Okla.	N	1970-80	30.6	363206	0960254
53	07177000	Hominy Creek near Skiatook, Okla.	N	1945-80	340	362055	0960635
54	07177500	Bird Creek near Sperry, Okla.	N	1939-84	905	361642	0955714
			R	1985-99			
55	07177650	Flat Rock Ck at Cincinnati Ave at Tulsa, Okla.	U	1989-99	8.20	361255	0955942

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Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
56	07177800	Coal Creek at Tulsa, Okla.	U	1989-99	7.53	361140	0955450
57	07178000	Bird Creek near Owasso, Okla.	R	1988-99	1,022	361454	0955201
58	07178040	Mingo Ck at 46th Street North at Tulsa, Okla.	U	1988-97	59.9	361314	0955130
59	07178200	Bird Ck at State Highway 266 nr Catoosa, Okla.	R	1989-99	1,103	361323	0954909
60	07178600	Verdigris River near Inola, Okla.	N	1945-62	7,911	360943	0953707
			R	1964-70			
61	07185000	Neosho River near Commerce, Okla.	N	1940-62	5,876	365543	0945726
			R	1964-99			
62	07185095	Tar Creek at 22nd Street Bridge at Miami, Okla.	U	1985-93	44.7	365400	0945205
63	07186000	Spring River near Waco, Mo. [4]	N	1925-99	1,164	371444	0943358
64	07188000	Spring River near Quapaw, Okla.	N	1940-99	2,510	365604	0944446
65	07189000	Elk River near Tiff City, Mo.	N	1940-99	872	363753	0943512
66	07189500	Neosho River near Grove, Okla.	N	1925-39	9,969	363645	0944925
67	07190500	Neosho River near Langley, Okla.	R	1940-99	10,335	362620	0950254
68	07191000	Big Cabin Creek near Big Cabin, Okla.	N	1948-99	450	363406	0950907
69	07191220	Spavinaw Creek near Sycamore, Okla.	N	1962-99	133	362007	0943827
70	07191500	Neosho River near Chouteau, Okla.	N	1938-39	11,534	361346	0951057
			R	1965-99			
71	07192000	Pryor Creek near Pryor, Okla.	N	1948-63	229	361652	0951932
72	07192500	Neosho River near Wagoner, Okla.	N	1925, 38-39	12,307	355544	0951608
			R	1940-49			
73	07193500	Neosho River below Fort Gibson Lake near Fort Gibson, Okla.	R	1954-89	12,495	355110	0951344
74	07194500	Arkansas River near Muskogee, Okla.	N	1926-52	84,133	354610	0951755
			R	1965-70			
75	07195500	Illinois River near Watts, Okla.	N	1956-99	635	360748	0943419
76	07195855	Flint Creek near West Siloam Springs, Okla.	R	1980-99	59.8	361258	0943615
77	07196000	Flint Creek near Kansas, Okla.	N	1956-99	110	361111	0944224
78	07196500	Illinois River near Tahlequah, Okla.	N	1936-99	959	355522	0945524
79	07196900	Baron Fork at Dutch Mills, Ark.	N	1959-99	40.6	355248	0942911
80	07197000	Baron Fork at Eldon, Okla.	N	1949-99	307	355516	0945018
81	07198000	Illinois River near Gore, Okla. [5]	N	1925, 40-51	1,626	353423	0950407
			R	1953-99			
82	07228500	Canadian River at Bridgeport, Okla.	N	1945-64	20,475	353237	0981903
			R	1970-99			
83	07229100	Canadian River near Noble, Okla.	N	1960-64	21,110	350455	0972252
			R	1965-75			
84	07229200	Canadian River at Purcell, Okla.	R	1980-83, 86-99	21,138	350050	0972050
85	07229300	Walnut Creek near Purcell, Okla.	N	1966-93	202	345956	0972200

Table 1. Summary of streamflow period of record used in study for selected continuous-record streamflow-gaging stations with at least 10 years of streamflow data from natural unregulated, regulated, and urban basins within and near Oklahoma—Continued

Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
86	07230000	Little River below Lake Thunderbird	N	1953-64	257	351318	0971249
		near Norman, Okla. [6]	R	1966-99			
87	07230500	Little River near Tecumseh, Okla.	N	1944-64	456	351021	0965554
			R	1966-99			
88	07231000	Little River near Sasakwa, Okla.	N	1943-61	884	345755	0963044
			R	1966-99			
89	07231500	Canadian River at Calvin, Okla.	N	1906, 39-42, 45-64	23,151	345840	0961436
			R	1965-99			
90	07232000	Gaines Creek near Krebs, Okla.	N	1943-63	588	345846	0953718
91	07232500	Beaver River near Guymon, Okla. [7]	N	1938-71	1,175	364317	1012921
			I	1978-93			
92	07232900	Coldwater Creek near Guymon, Okla. [7]	I	1981-99	725	363419	1012252
93	07233000	Coldwater Creek near Hardesty, Okla. [7]	N	1940-64	767	363838	1011238
94	07234000	Beaver River at Beaver, Okla. [7]	N	1938-71	3,685	364920	1003108
			IR	1979-99			
95	07234100	Clear Creek near Elmwood, Okla.	N	1966-93	170	363842	1003007
96	07234500	Beaver River near Fort Supply, Okla.	N	1938-50	5,068	363530	0993530
97	07235000	Wolf Creek at Lipscomb, Tex. [7]	N	1938-42	475	361419	1001631
			R	1962-71			
			IR	1978-99			
98	07236000	Wolf Creek near Fargo, Okla. [7]	N	1943-71	1,386	362357	0993722
99	07237000	Wolf Creek near Fort Supply, Okla. [7]	N	1938-41	1,498	363400	0993305
			R	1943-71			
			IR	1978-93			
100	07237500	North Canadian River at Woodward, Okla. [7]	N	1939-71	6,777	362612	0991641
			IR	1979-99			
101	07238000	North Canadian River near Seiling, Okla. [7]	N	1947-71	7,414	361100	0985515
			IR	1979-99			
102	07239000	North Canadian River at Canton, Okla.	N	1938-47	7,601	360437	0983547
			R	1949-93			
103	07239300	N.Canadian R. blw Weavers Ck nr Watonga,Okla.	R	1984-99	7,837	354843	0982514
104	07239450	North Canadian River near Calumet, Okla.	R	1989-99	8,063	353701	0980354
105	07239500	North Canadian River near El Reno, Okla.	N	1903-07, 38-47	8,143	353347	0975726
			R	1949-99			
106	07241000	N. Canadian R. blw Lk Overholser nr OKC, Okla.	R	1953-99	8,323	352843	0973947
107	07241500	North Canadian R. near Oklahoma City, Okla. [8]	R	1940-53, 60	8,455	352940	0972540
108	07241520	North Canadian R. at Britton Road at OKC, Okla.	R	1989-99	8,514	353356	0972201
109	07241550	North Canadian River near Harrah, Okla.	R	1969-99	8,602	353001	0971137
110	07242000	North Canadian River near Wetumka, Okla.	R	1938-99	9,391	351556	0961221

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Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
111	07242350	Deep Fork near Arcadia, Okla.	U	1970-86	105	353850	0972135
			UR	1988-93			
112	07242380	Deep Fork near Warwick, Okla.	N	1984-86	532	354051	0970029
			R	1988-99			
113	07243000	Dry Creek near Kendrick, Okla.	N	1956-94	69.0	354655	0965114
114	07243500	Deep Fork near Beggs, Okla.	N	1939-67	2,018	354026	0960406
			R	1968-99			
115	07244000	Deep Fork near Dewar, Okla.	N	1938-50	2,307	352843	0955257
116	07245000	Canadian River near Whitefield, Okla.	N	1939-63	37,876	351550	0951421
			R	1965-99			
117	07245500	Sallisaw Creek near Sallisaw, Okla.	N	1943-63	182	352752	0945143
			R	1964-76			
118	07247000	Poteau River at Cauthron, Ark.	N	1940-72	203	345508	0941755
			R	1975-99			
119	07247500	Fourche Maline near Red Oak, Okla.	N	1939-63	122	345445	0950920
			R	1966-99			
120	07248500	Poteau River near Wister, Okla.	N	1939-48	993	345615	0944254
			R	1950-84			
121	07249400	James Fork near Hackett, Ark.	N	1959-99	147	350945	0942425
122	07249985	Lee Creek near Short, Okla. [9]	N	1931-99	420	353109	0942758
123	07250550	Arkansas River at James W. Trimble L&D near Van Buren, Ark. [10]	N	1928-63	128,306	352056	0941754
			R	1970-98			
124	07299540	Prairie Dog Town Fork Red R. nr Childress, Tex.	N	1966-99	2,958	343409	1001137
125	07299570	Red River near Quanah, Tex.	N	1961-82	3,552	342447	0994403
126	07300000	Salt Fork Red River near Wellington, Tex. [11]	N	1953-66	1,013	345727	1001314
			R	1968-99			
127	07300500	Salt Fork Red River at Mangum, Okla.	N	1938-99	1,357	345130	0993030
128	07301110	Salt Fork Red River near Elmer, Okla.	N	1980-99	1,669	342844	0992255
129	07301410	Sweetwater Creek near Kelton, Tex.	N	1963-99	267	352823	1000714
130	07301420	Sweetwater Creek near Sweetwater, Okla.	N	1987-99	404	352520	0995808
131	07301500	North Fork Red River near Carter, Okla. [12]	N	1945-99	1,938	351005	0993025
132	07303000	North Fork Red River below Altus Dam near Lugert, Okla.	R	1951-62, 65-69, 76-99	2,116	345326	0991822
133	07303400	Elm Fork of North Fk Red R. nr Carl, Okla.	N	1960-79, 95-99	416	350042	0995412
134	07303500	Elm Fork of North Fk Red R. nr Mangum, Okla.	N	1906-07, 31, 38-47 66-67, 69-76	838	345536	0993000
135	07304500	Elk Creek near Hobart, Okla.	N	1905-07, 50-66	549	345451	0990649
			R	1967-93			

Table 1. Summary of streamflow period of record used in study for selected continuous-record streamflow-gaging stations with at least 10 years of streamflow data from unregulated, regulated, and urban basins within and near Oklahoma—Continued

Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
136	07305000	North Fork Red River near Headrick, Okla.	N	1906-07, 38-43	3,845	343804	0990547
			R	1945-99			
137	07305500	West Otter Creek at Synder Lake near Mountain Park, Okla.	N	1904-07	132	344402	0985910
			R	1951-71, 73-75			
			R	1976-99			
138	07307028	North Fork Red River near Tipton, Okla.	R	1985-99	4,292	343025	0991228
139	07308500	Red River near Burkburnett, Tex.	N	1961-99	14,634	340636	0983153
140	07311000	East Cache Creek near Walters, Okla.	N	1939-60	675	342144	0981656
			R	1962-99			
141	07311200	Blue Beaver Creek near Cache, Okla.	N	1965-99	24.6	343724	0983348
142	07311500	Deep Red Creek near Randlett, Okla.	N	1950-99	617	341315	0982710
143	07313000	Little Beaver Creek near Duncan, Okla. [13]	N	1949-63	158	342936	0980642
144	07313500	Beaver Creek near Waurika, Okla.	N	1954-76	563	341300	0980257
			R	1978-93			
145	07315500	Red River near Terral, Okla.	N	1939-43	22,787	335243	0975603
			R	1945-99			
146	07315700	Mud Creek near Courtney, Okla.	N	1961-99	572	340015	0973400
147	07316000	Red River near Gainesville, Tex.	N	1937-43	24,846	334340	0970935
			R	1945-99			
148	07316500	Washita River near Cheyenne, Okla.	N	1938-60	794	353735	0994005
			R	1961-99			
149	07319500	Sandstone Creek near Berlin, Okla.	R	1953-72	40.9	353026	0993327
150	07323000	Sandstone Creek near Cheyenne, Okla.	R	1952-73	83.1	353310	0993150
151	07324200	Washita River near Hammon, Okla.	R	1970-87, 90-99	1,387	353923	0991821
152	07324400	Washita River near Foss, Okla.	R	1962-87, 90-99	1,551	353220	0991010
153	07325000	Washita River near Clinton, Okla.	N	1936-60	1,977	353151	0985800
			R	1962-99			
154	07325500	Washita River at Carnegie, Okla.	N	1938-60	3,129	350702	0983349
			R	1962-99			
155	07325800	Cobb Creek near Eakly, Okla.	R	1969-99	132	351726	0983538
156	07326000	Cobb Creek near Fort Cobb, Okla.	N	1940-58	307	350837	0982633
			R	1960-99			
157	07326500	Washita River at Anadarko, Okla.	N	1903-08, 36-37	3,656	350503	0981435
			R	1964-99			
158	07327000	Sugar Creek near Gracemont, Okla.	N	1956-62	208	351030	0981520
			R	1963-74			
159	07327490	Little Washita River near Ninnekah, Okla. [14]	N	1964-73	208	345641	0975708
			R	1974-85			
160	07328000	Washita River near Tabler, Okla.	N	1940-52	4,706	345818	0975221

Table 1. Summary of streamflow period of record used in study for selected continuous-record streamflow-gaging stations with at least 10 years of streamflow data from unregulated, regulated, and urban basins within and near Oklahoma—Continued

Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
161	07328070	Winter Creek near Alex, Okla.	N	1965-66	33.0	345935	0974540
			R	1967-86			
162	07328100	Washita River at Alex, Okla.	R	1965-86, 89-99	4,787	345533	0974625
163	07328500	Washita River near Pauls Valley, Okla.	N	1938-60	5,330	344517	0971504
			R	1962-99			
164	07329000	Rush Creek at Purdy, Okla.	N	1940-53	145	344146	0973555
			R	1983-93			
165	07329500	Rush Creek near Maysville, Okla. [15]	N	1955-64	206	344436	0972418
			R	1965-76			
166	07329700	Wild Horse Creek near Hoover, Okla.	R	1970-93	604	343229	0971449
167	07329852	Rock Creek at Sulphur, Okla.	R	1990-99	44.1	342943	0965918
168	07330500	Caddo Creek near Ardmore, Okla.	N	1937-50	298	341433	0970628
			R	1997			
169	07331000	Washita River near Dickson, Okla.	N	1929-60	7,202	341400	0965832
			R	1962-99			
170	07331600	Red River at Denison Dam nr Denison, Tex. [16]	N	1924-43	33,784	334908	0963347
			R	1945-89, 98-99			
171	07332400	Blue River at Milburn, Okla.	N	1966-86	203	341504	0963305
172	07332500	Blue River near Blue, Okla.	N	1937-99	476	335949	0961427
173	07333500	Chickasaw Creek near Stringtown, Okla. [17]	N	1956-68	32.7	342741	0960136
174	07333800	McGee Creek near Stringtown, Okla. [17]	N	1957-68	86.6	342633	0955210
175	07334000	Muddy Boggy Creek near Farris, Okla.	N	1938-86	1,087	341617	0955443
			R	1988-99			
176	07335000	Clear Boggy Creek near Caney, Okla.	N	1943-61	720	341509	0961219
			R	1965-89			
177	07335300	Muddy Boggy Creek near Unger, Okla.	N	1983-99	2,273	340136	0954500
178	07335500	Red River at Arthur City, Tex.	N	1906-11, 37-43	38,595	335230	0953006
			R	1945-99			
179	07335700	Kiamichi River near Big Cedar, Okla. [18]	N	1966-99	40.1	343818	0943645
180	07335790	Kiamichi River near Clayton, Okla.	N	1982	708	343429	0952026
			R	1984-99			
181	07336000	Tenmile Creek near Miller, Okla. [1]	N	1956-70	68.0	341755	0954440
182	07336200	Kiamichi River near Antlers, Okla. [18]	N	1973-82	1,138	341455	0953618
			R	1984-99			
183	07336500	Kiamichi River near Belzoni, Okla.	N	1926-72	1,423	341202	0952903
184	07336820	Red River near DeKalb, Tex. [19]	R	1969-98	41,412	334059	0944139
185	07337500	Little River near Wright City, Okla.	N	1930-68	645	340410	0950247
			R	1970-89			

Table 1. Summary of streamflow period of record used in study for selected continuous-record streamflow-gaging stations with at least 10 years of streamflow data from unregulated, regulated, and urban basins within and near Oklahoma—Continued

Site number (fig. 1)	Station number	Station name	Type of record (I/N/R/U)	Period of record (complete water year)	Contributing drainage area (mi^2)	Latitude (dms)	Longitude (dms)
186	07337900	Glover River near Glover, Okla.	N	1962-99	315	340551	0945407
187	07338500	Little River below Lukfata Creek	N	1947-68	1,226	335628	0944530
		near Idabel, Okla. [20]	R	1970-99			
188	07339000	Mountain Fork near Eagletown, Okla.	N	1925, 1930-68	787	340230	0943711
			R	1969-99			

[1] Crest-stage partial-record site beginning WY 1971
[2] Statistical analyses include streamflow record from nearby station 07161000
[3] Statistical analyses include streamflow record from nearby station 07174000
[4] Historical record length assumed equal to that for nearby station 07188000 for peak-flow frequency analysis
[5] Historical record length assumed to start from same year as that for nearby station 07196500 for peak-flow frequency analysis of unregulated streamflow period
[6] Historical record length assumed equal to that for nearby station 07230500 for peak-flow frequency analysis of unregulated streamflow period
[7] Pre- and post-irrigation development as defined in Wahl and Tortorelli (1997)
[8] Historical record length assumed equal to that for nearby station 07241000 for peak-flow frequency analysis
[9] Was 07250000, Lee Creek near Van Buren, Ark., prior to WY 1993 and above Lee Creek Reservoir.
[10] Was 07250500, Arkansas River at Van Buren, Ark., prior to WY 1970
[11] Historical record length assumed to start from same year as that for nearby station 07299850 for peak-flow frequency analysis of unregulated streamflow period
[12] Statistical analyses include streamflow record from nearby station 07302000
[13] Historical record length assumed equal to that for nearby station 07313500 for peak-flow frequency analysis
[14] Statistical analyses include streamflow record from nearby station 07327500
[15] Crest-stage partial-record site beginning WY 1977
[16] Statistical analyses include streamflow record from nearby station 07332000
[17] Crest-stage partial-record site beginning WY 1969
[18] Historical record length assumed to start from same year as that for nearby station 07336500 for peak-flow frequency analysis of unregulated streamflow period
[19] Historical record length assumed to start from same year as that for nearby station 07335500 for peak-flow frequency analysis of regulated streamflow period
[20] Statistical analyses include streamflow record from nearby station 07338000

Table 2. Summary of drainage area distribution of streamflow statistics analyses for streamflow-gaging sites

Contributing drainage area (square miles)	Number of streamflow statistics analyses		
	Unregulated	Regulated, Urban and Irrigation	Total
1 to less than 10	0	4	4
10 to less than 100	9	11	20
100 to less than 500	35	19	54
500 to less than 1,000	23	17	40
1,000 to less than 5,000	31	29	60
5,000 to less than 10,000	13	15	28
10,000 to less than 50,000	13	17	30
50,000 or more	3	3	6
Total	127	115	242

preceded by a station description and include mean annual discharges, magnitude and probability of exceedance of annual high flows, magnitude and probability of exceedance of annual instantaneous peak flows, durations of daily mean flow, magnitude and probability of non-exceedance of annual low flows, and magnitude and probability of non-exceedance of seasonal low flows. An alphabetical index is provided to assist the reader, listed by both stream and nearby municipality.

The beginning and end years are listed for complete water years in the period of record analyzed for mean annual discharges, magnitude and probability of exceedance of annual high flows, and durations of daily mean flow. The beginning and end years are listed for water years in the record analyzed for annual instantaneous peak flows. The beginning and end years are listed for complete climatic years or seasons in the period of record analyzed for annual and seasonal low flows. If there are gaps in the period of record at the site, or incomplete years of record, this is noted in the station description.

The mean daily streamflow values were retrieved with the computer program Automated Data Processing System (ADAPS) (USGS, 1998a) and processed using the computer program Input and Output for Watershed Data Management (IOWDM) (USGS, 1998b). Mean annual statistics, high-flow, flow-duration, and low-flow statistics were then computed with the computer program Surface-Water Statistics (SWSTAT) (USGS, 1998c). Instantaneous peak-flow statistics were calculated using the Annual Flood Frequency Analysis computer program (PEAKFQ) (USGS, 1998d) as reported in Tortorelli and McCabe (2001).

Station descriptions

The station descriptions include: station location, drainage area, period of record, and remarks. Remarks include information on the chronological history of regulating structures and comments on the other factors that may affect natural flow.

Mean annual discharges

This table lists the mean annual discharge based on the period of record. The table value is based on water year, which is the 12-month period October 1 through September 30. The water year is designated by the calendar year which it ends; thus the water year ending September 30, 1999, is called the "water year 1999".

Annual high-flow frequency

High-flow frequency data are developed from an annual series of the highest mean discharges for some specified "n"-day consecutive time period. For example, an annual series of 3-day high flows consists of the highest mean discharge that occurs over any 3-day consecutive period during each year of record. The annual "n"-day high flows commonly are computed for consecutive periods of 1, 3, 7, 10, 30, and 60 days.

The Pearson Type III distribution is a 3-parameter distribution that requires estimates of the population mean, standard deviation, and skew coefficient. For application of "n"-day high and low flows, the population values are assumed to be equal to the values computed from the station record. For application to peak flows, the population skew coefficient commonly is determined by weighting the station-record skew coefficient with values determined from a regional skew map as described in the annual instantaneous peak-flow frequency section of this report.

This table lists statistical data determined by fitting the logarithm of annual "n"-day high flow to a Pearson Type III distribution (USGS, 1998c; IACWD, 1982). Results from the log Pearson Type III analyses are shown for recurrence intervals of 2, 5, 10, 25, 50, and 100 years. The table also displays computed results in terms of exceedance probabilities in percent: 50, 20, 10, 4, 2, and 1 percent, respectively. Exceedance probability (in decimal form, before conversion to percent) is the reciprocal of the recurrence interval.

Each discharge in the table is a mean high flow for an "n"-day consecutive period of days that can be expected to be equaled or exceeded ***on the average*** once every "y"-years, where "y" is the recurrence interval. Similarly, each high flow in the table has an "x"-percent probability of exceedance in any given year, where "x" is the exceedance probability, in percent. For example, the high-flow corresponding to the 100-year recurrence interval and 3-day consecutive period of days can be expected to be equaled or exceeded ***on the average*** once every 100-years; similarly, a high flow corresponding to 1 percent exceedance probability and 3-day consecutive days will have a 1 percent chance of being equaled or exceeded in any given year.

For any "n"-day period, discharges increase for increasing recurrence interval and decreasing exceedance probability. Conversely, for any given recurrence interval, or exceedance probability, discharge decreases with increasing "n"-day period.

The high flows based on mean daily discharge will be lower than the instantaneous peak flows. More record is often available on instantaneous peaks and, therefore, are usually a more reliable estimate. These data will be described in the next section. High-flow frequency curves for 46 streamflow analyses were adjusted downward based on the instantaneous peak-flow frequency data, and an average of five values per analyses were corrected.

Annual instantaneous peak-flow frequency

Peak-flow frequency data are developed from an annual series of the highest instantaneous peak discharges for the period of record at a station. For example, an annual series of instantaneous peak flows consists of the highest instantaneous peak discharge that occurs during each year of record.

This table lists statistical data determined by fitting the logarithm of annual instantaneous peak flow to a Pearson Type III distribution (USGS, 1998d; IACWD, 1982). Results from the log Pearson Type III analyses are shown for recurrence intervals of 2, 5, 10, 25, 50, 100, and 500 years. The table also displays computed results in terms of exceedance probabilities in percent; 50, 20, 10, 4, 2, 1, and 0.2 percent, respectively. Exceedance probability is the reciprocal of the recurrence interval.

Each discharge in the table is an instantaneous peak flow that can be expected to be equaled or exceeded ***on the average*** once every "y"-years, where "y" is the recurrence interval. Similarly, each instantaneous peak flow in the table has an "x"-percent probability of exceedance in any given year, where "x" is the exceedance probability, in percent. For example, the instantaneous peak flow corresponding to the 100-year recurrence interval can be expected to be equaled or exceeded ***on the average*** once every 100-years; similarly, an instantaneous peak flow corresponding to 1 percent exceedance probability will have a 1 percent chance of being equaled or exceeded in any given year.

Skewness may be shown graphically as right or left relative to a normal distribution; in this report, it is described mathematically by a number, either negative or positive. As noted in the previous section, skew values are used in the calculation of the frequency curve statistics (IACWD, 1982; Tortorelli and McCabe, 2001). Skew values are commonly reported with instantaneous peak-flow statistics, but not with low- or high-flow statistics.

The value of skew coefficient used for each station analysis listed at the bottom of the peak-flow frequency table. The skew is described as "Oklahoma weighted skew" if it was determined for those unregulated streamflow stations with drainage area of less than 2,500 square miles by weighting the station-record skew with skew from a generalized skew map developed for Oklahoma streams by Tortorelli and Bergman (1985) as described in Bulletin 17B (IACWD, 1982). The mean square error of the Oklahoma generalized skew map was used in the weighting process (Tortorelli and Bergman, 1985). The skew for those unregulated streamflow stations with a drainage area more than 2,500 square miles is described as "Water Resources Council weighted skew" if it was determined by weighting the station-record skew with skew from a generalized national skew map developed by the U.S. Water Resources Council as described in Bulletin 17B (IACWD,1982). The mean square error of the U.S. Water Resources Council generalized skew map was used in this weighting process (IACWD,1982).

The skew is described as "station skew" if station-record skew only was used for streamflow stations regulated by reservoirs and floodwater-retarding structures and human modifications of streamflow. No station with a drainage area more than 2,500 square miles was considered as regulated solely by floodwater-retarding structures.

A more detailed discussion of the log Pearson Type III analysis for instantaneous peak flow, including the use of historic years, and high- and low-outliers, may be found in Tortorelli and McCabe (2001).

Flow duration

Flow-duration data are developed from all the daily-mean discharge values over the entire period of record. This table lists data to plot a flow-duration curve (Searcy, 1959). A flow-duration curve is a cumulative frequency curve that shows how often a particular discharge has been exceeded based on the period of record. The flow-duration curve is not related to the sequence of flow events, but does include the full range of daily-mean discharges at the station. For example, the discharge value on a flow-duration table that corresponds to a 10 percent exceedance is the value that was exceeded on 10 percent of the flow record without regard for when those days of exceedance occurred. The days of exceedance may not have been consecutive, and may have occurred either in a single year or have been distributed over several years (Ludwig, 1992).

Annual and seasonal low-flow frequencies

Annual low-flow frequency data are developed from an annual series of the lowest mean discharges for some specified "n"-day consecutive time period. For example, an annual series of 7-day low flows consists of the lowest mean discharge that occurs over any 7-day consecutive period during each year of record. The data in the annual low-flow frequency tables were produced by fitting the logarithms of annual "n"-day low flows to a Pearson Type III distribution (USGS, 1998c).

Seasonal low-flow frequency data are developed from an annual series of the lowest mean discharges for each of the spring (April through May), summer (June through October), and winter (November through March) seasons for some specified "n"-day consecutive time period. The data in the seasonal low-flow frequency tables were produced by fitting the logarithms of the annual series of seasonal "n"-day low flows to a Pearson Type III distribution.

The low-flow frequency data indicate lowest mean discharges for consecutive periods of 1, 3, 7, 10, 30, and 60 days and at recurrence intervals of 2, 5, 10, and 20 years, which correspond to non-exceedance probabilities of 50, 20, 10, and 5 percent, respectively.

Each discharge in the annual or seasonal low-flow table is a mean low flow within the year or season for an "n"-day consecutive period of days that can be expected to be lower ***on the average*** once every "y"-years, where "y" is the recurrence interval. Similarly, each low flow in the table has an "x"-percent probability that, in any given year, a smaller value "n"-day mean low flow will occur, where "x" is the non-exceedance probability, in percent. For example, the low-flow corresponding to the 2-year recurrence interval and 7-day consecutive period of days can be expected to be lower ***on the average*** once every 2-years; similarly, a low flow corresponding to 50-percent non-exceedance probability and 7-day consecutive days will have a 50-percent chance of being lower in any given year.

For any "n"-day period, discharges decrease for increasing recurrence interval and decreasing non-exceedance probability. Conversely, for any given recurrence interval, or non-exceedance probability, discharge increases with increasing "n"-day period.

Annual low flows are calculated based on a climatic year (April 1 to March 31); thus the period of record for a climatic year is one year less than for a water year (Riggs, 1972). Seasonal low flows are calculated based on the growth seasons defined earlier. The values listed in the tables were computed from U.S. Geological Survey computer program Surface-Water Statistics (USGS, 1998c) utilizing days of zero flow rather than omitting zero flow days as was done prior to Heimann and Tortorelli (1988). Values may differ, due to this updated method of computation, from those in the study by Huntzinger (1978b), because the frequency analysis for that report was determined graphically and utilized only flows greater than zero. These differences are especially significant for streams in drier regions of Oklahoma.

The low-flow frequency curves for given "n"-day periods were computed independently. Inclusion of zero-flow days in the independent analyses resulted in some anomalies in the frequency tables. The anomalies were some "n"-day low flows that did not consistently decrease with increasing recurrence interval, or low-flows for a given recurrence interval that did not consistently increase with increasing "n"-day period. These anomalies in the data are termed data reversals and were adjusted to produce consistent tabular results. Also in some instances, seasonal low flows for a given "n"-day period and recurrence interval were calculated to be smaller than the annual values, which usually occurred due to round-off error. Therefore, annual low flows were adjusted downward slightly to match the lowest seasonal low flows. Tables for 153 streamflow analyses were adjusted graphically for data reversals. An average of 6 values per analysis were adjusted.

SUMMARY

Information about mean annual flow, low-flow and high-flow characteristics, and flow-duration statistics is essential to water-management agencies dealing with problems related to irrigation, municipal and industrial water supplies, and fish and wildlife conservation. Low-flow statistics are particularly important to assess the capability of a stream to receive and assimilate treated wastewater. Low-flow statistics are used in developing wastewater permits and determining total maximum daily loads of streams. Annual and seasonal 7-day, 2-year low-flow streamflows are used as part of the criteria for developing wasteload allocations for permit purposes and is specifically cited in State statutes. Other low-flow durations (1, 3, 10, 30, and 60 days) and frequencies (5, 10, and 20 years) also are useful to characterize streamflow at a site.

Knowledge of high-flow and peak-flow statistics is required for the safe and economical design of highway bridges, culverts, dams, levees, and other structures on or near streams and for disaster planning. Flood plain management programs and flood-insurance rates also are based on peak-flow magnitude and frequency information.

The purposes of this report are to: (1) update mean annual flow, annual low- and high-flow statistics, and flow-duration statistics for each streamflow gaging station with 10 years or more of streamflow record; (2) present seasonal low-flow statistics of these gaging stations for three Oklahoma growth seasons: (a) spring (April 1 - May 31), (b) summer (June 1 - October 31), and (c) winter (November 1 - March 31); (3) update peak-flow statistics of these gaging stations; and (4) present analyses of unregulated and regulated periods of record separately, to reconcile changes in streamflow due to regulating structures and other human modifications of streamflow.

Statistical summaries of streamflow records through 1999 for gaging stations in Oklahoma and parts of adjacent states are presented. Only continuous-record sites with at least 10 years of unregulated or regulated data were selected for analysis. A total of 188 streamflow-gaging stations were selected, 174 in Oklahoma and 14 on major rivers in adjacent states. Streamflow at 113 of the stations is affected by regulation, urbanization, or irrigation well development for specific periods. Fifty-two of the 113 stations were analyzed for both unregulated and human-modified periods. Two of the regulated sites in the 113 stations were analyzed for periods of flow regulation and separate periods of flow regulation with irrigation development.

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